Quarkonium TG Progress

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Upsilon Analysis

- The observable we plan to measure Y(1S), Y(2S), Y(3S) R_{AA} as a function of collision centrality and Y p_T.

- Signal statistical precision that translates directly into Y(1S), Y(2S), Y(3S) R_{AA} and depends on
  - ✓PID efficiency (in depth studies done last Fall and currently in progress to account for non-uniformity response of the calorimeter)
  - ✓Combinatorial and Correlated Backgrounds (new and finalised)
  - ✓Tracking efficiency and momentum resolution (well understood by tracking group)

Basic Assumptions

- These assumptions are used in the following slides but will need to be revised to be consistent with the new 5-year run plan

Species	$\int \mathbf{L\,dt}(\lvert\mathbf{Z}\rvert < \mathbf{10cm})$	Events	$\langle N_{coll} \rangle$	eID eff.	Y(1S)	Y(2S)	Y(3S)
$p+p$	175 pb^{-1}	7350 B	1		8770	2205	1155
Au+Au (MB)		100 B	240.4		16240	4080	2140
Au+Au (0–10%)		10 B	962		5625	1415	740

Background Issues

- Framework for inclusive background estimate existed and was modified to produce background plots as a function of "electron" pair pT. Progress reported regularly by Sasha Lebedev at simulations meetings, link to in progress note posted at https://wiki.bnl.gov/sPHENIX/index.php/Upsilon_Topical_Group

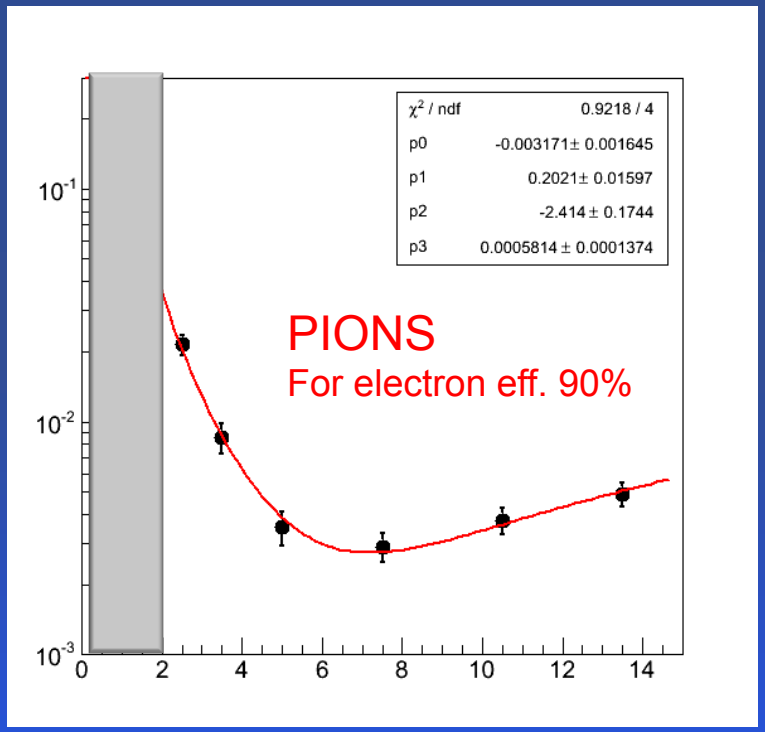
To be redone ✓ Determine with realistic clustering and detector configuration in central Au-Au collisions as a function of eta and pt

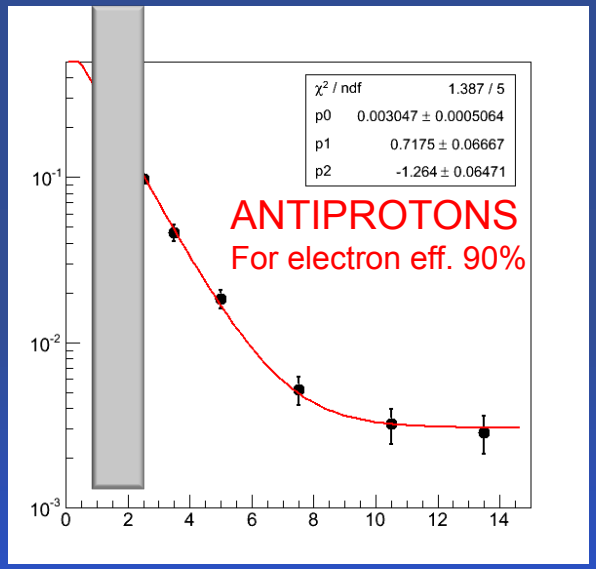
- electron PID efficiency (fixed to 70% and 90%)
- hadron rejection factors

done ✓ Determine correlated background (bottom, charm semileptonic decays and DY) -

Hadron Rejection

- In the past we assumed a fixed hadron rejection factor of 90
- Last Fall new hadron rejection factors were calculated embedding of single particles in central (0-4.4fm) Hijing events and running full reconstruction chain were determined last Fall. For 70% eID efficiency rejection is ~2.5 times better.
- Currently S. Lebedev is repeating this with most recent calorimeter response.





proton and kaon rejections are better than that for pions

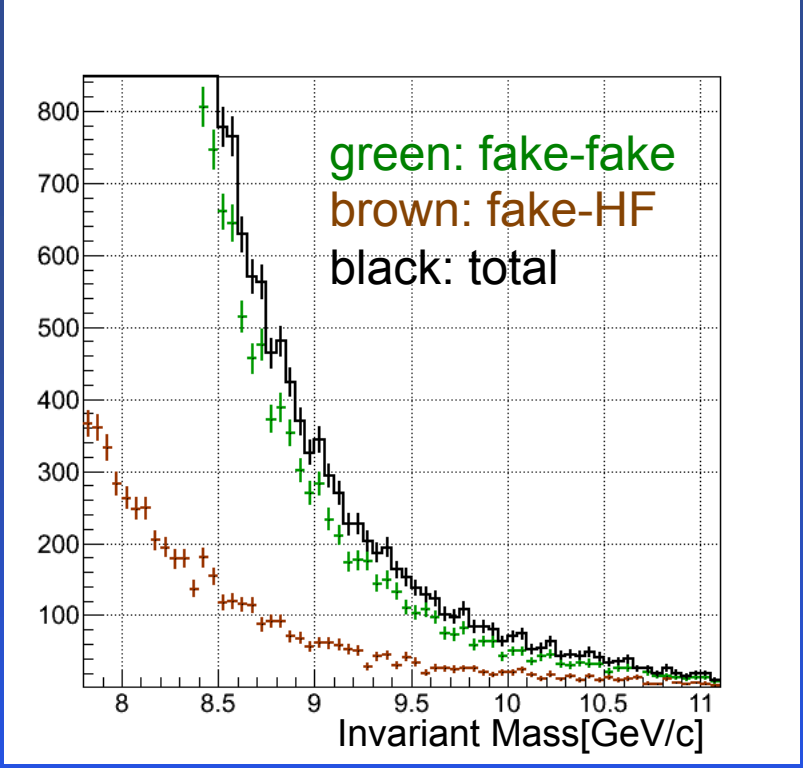
Combinatorial Background

- We calculate background for 10B 0-10% central Au+Au events.We use p_T>2GeV/c cut, which does not affect Upsilons.
- Take fits to hadron spectra in p+p, scale by N_{COLL} and R_{AA}, downscale by hadron rejection.
- This gives us dN/dp_T per events for “fake electrons” in central Au+Au collisions.
- For each event, generate number of fake electrons (smeared Poisson), for each fake electron generate kinematics (p_T, etc.). Calculate invariant mass.
- Do the same for fake electron / heavy flavor combinations.

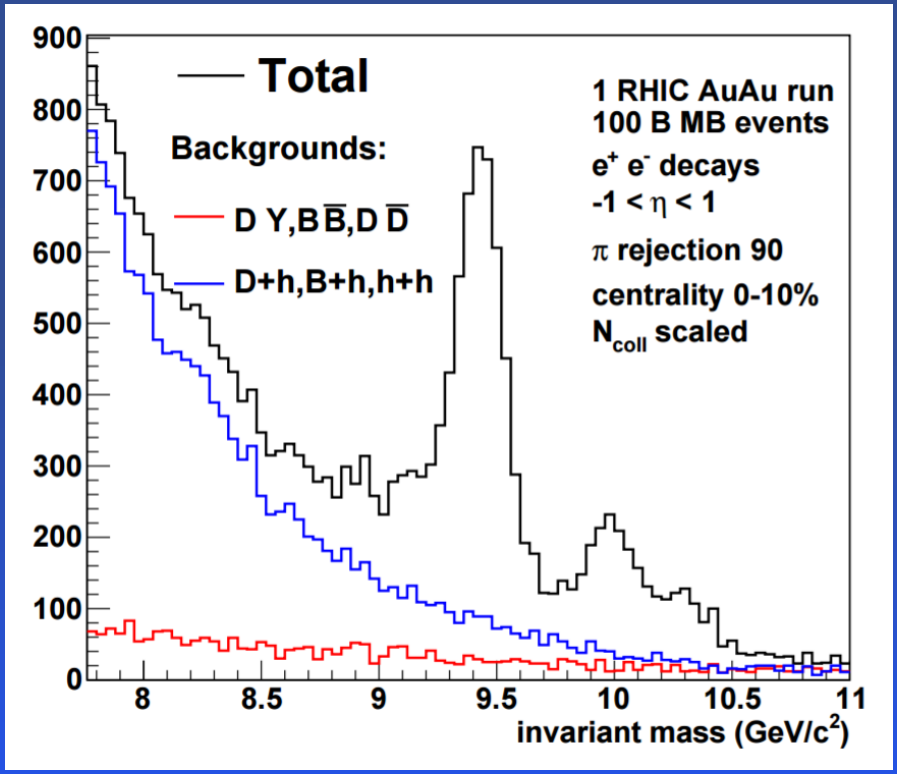
Combinatorial Background

Combinatorial backgrounds comparable to the one in proposal despite larger rejection at high pT due to:
1) anti-protons 2) 90% eID vs. 70 % eID, 3) bad rejection at low pT

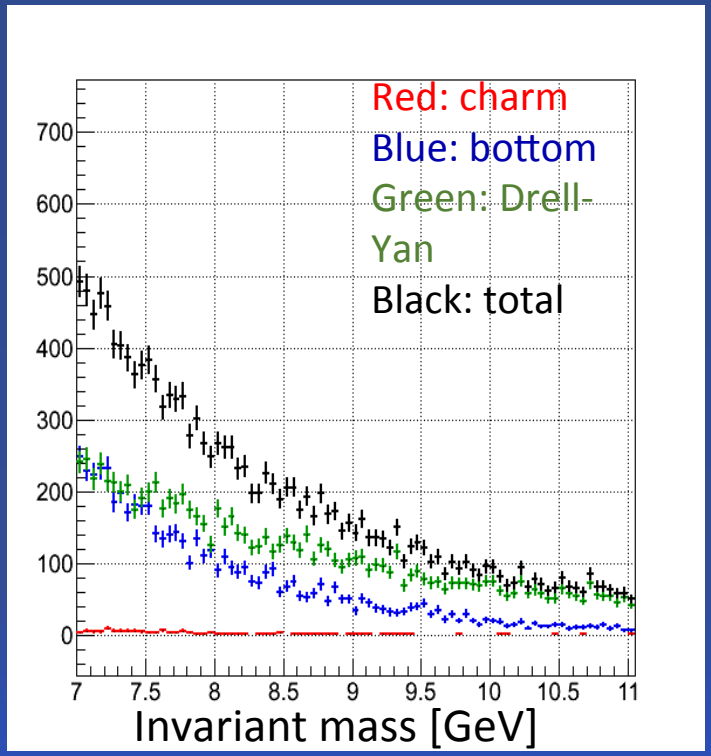
NEW

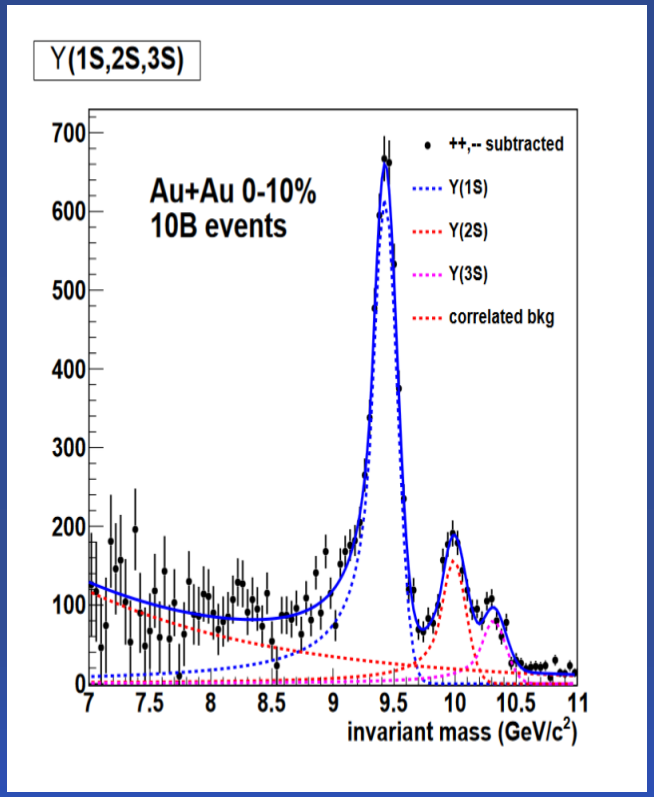


sPHENIX proposal



Correlated background (eID=90%)

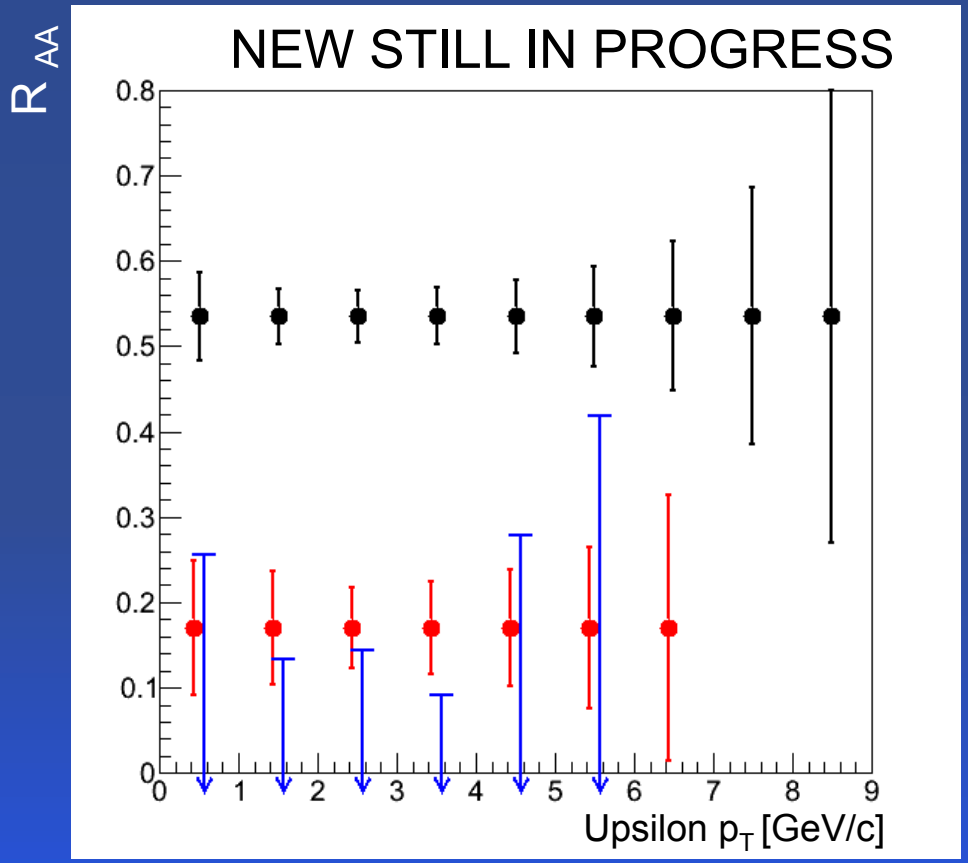




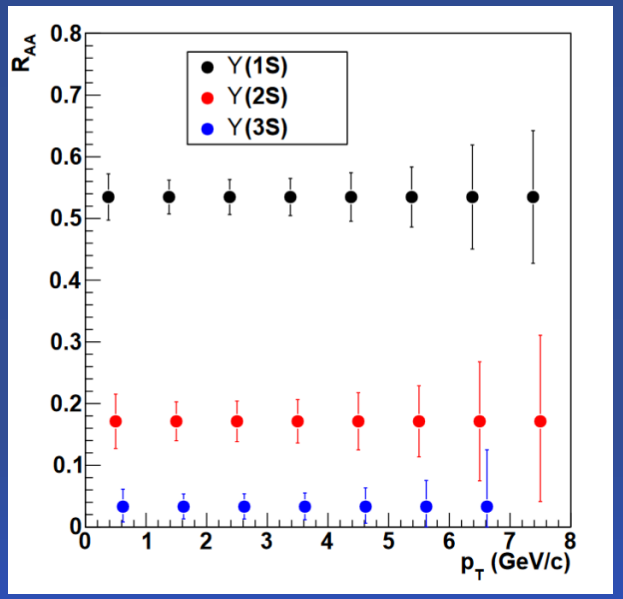
The new plot uses 90% eID efficiency and 50 MeV bins.

New correlated background is approximately 1.5-2 times larger in 9-10 GeV range.

eID efficiency 70% realistic suppression

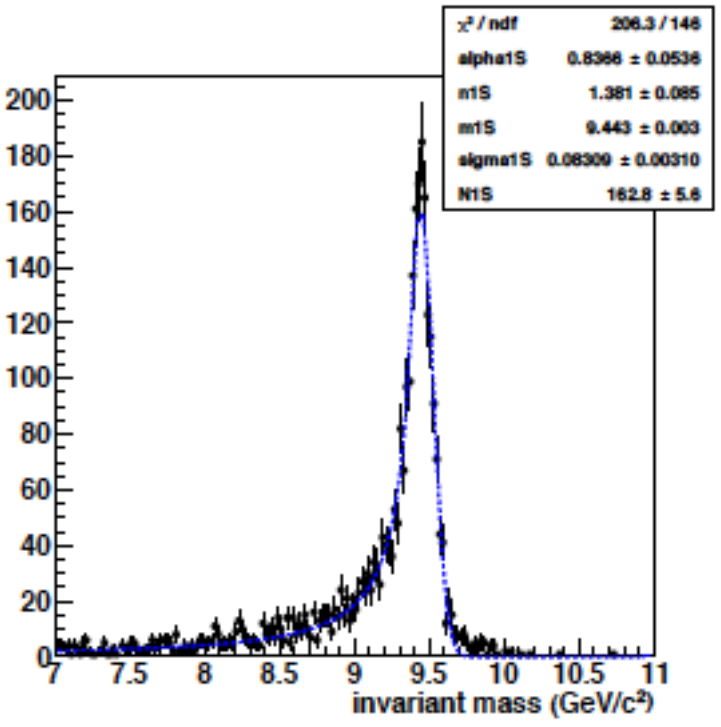


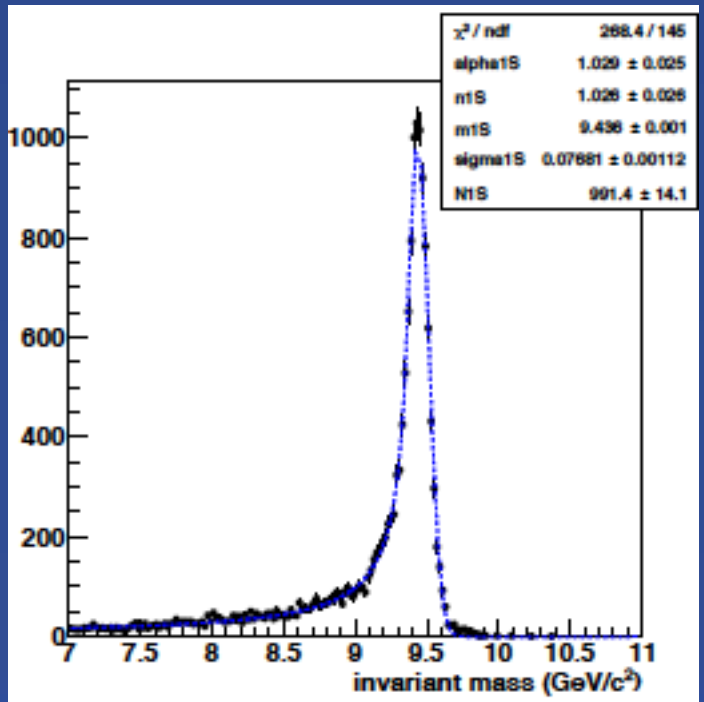
sPHENIX proposal



Invariant Mass vs TPC design

single Upsilons 60 TPC layers
|Z| < 10, |y| < 1.1
σ = 76.8 ± 1.1 MeV

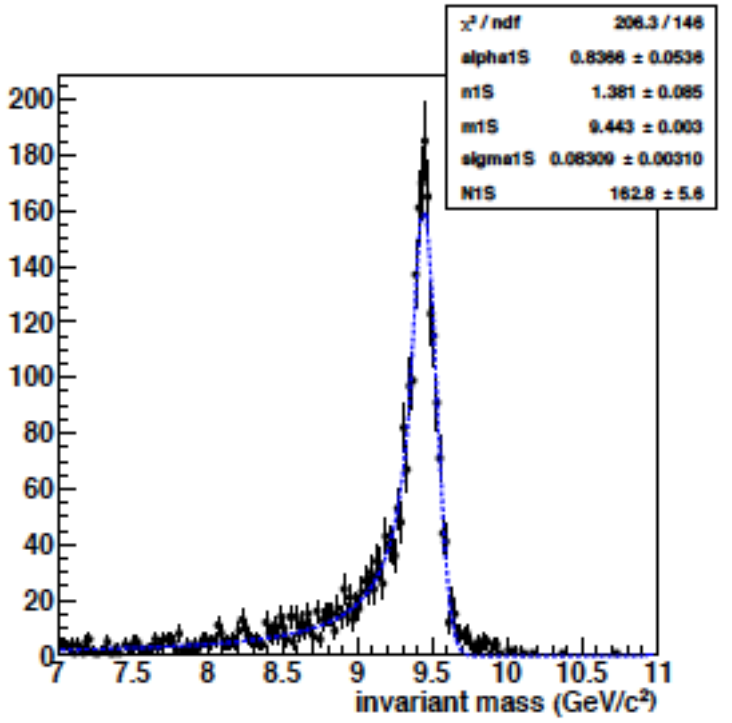


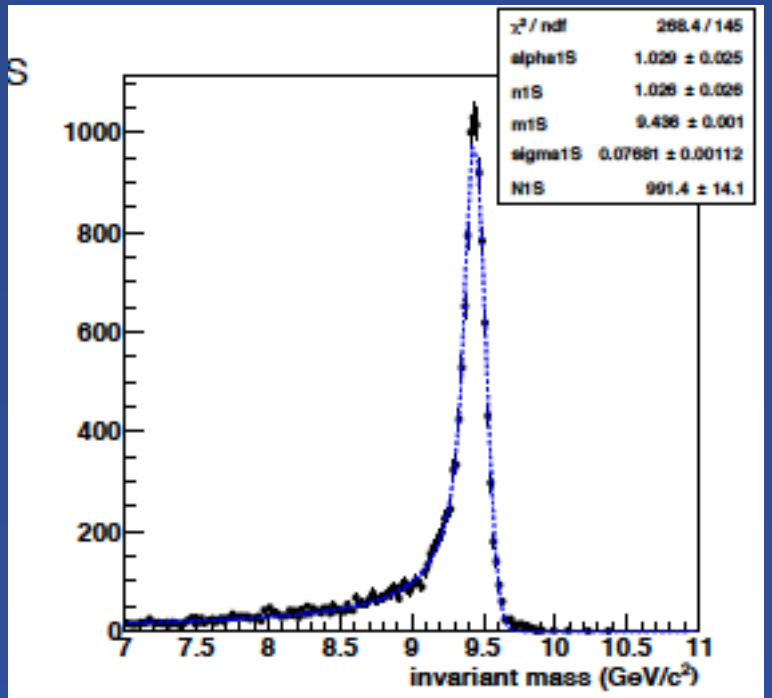


single Upsilons 40 TPC layers
Z = 0, y < 1.1
σ = 81.2 ± 1.2 MeV

Invariant Mass vs Occupancy

single Upsilons 60 TPC layers
|Z| < 10, |y| < 1.1
σ = 76.8 ± 1.1 MeV





Upsilons embedded in central Hijing events 60 TPC layers
Z = 0, y < 1.1
σ = 83 ± 3 MeV

Plans

- Complete the Upsilon signal vs P_T
- Redo PID studies and background simulations
- Produce RAA plots with number of events consistent with 5 year run plan

Acknowledgments

- Plots provided by:
  - Sasha Lebedev
  - Tony Frawley

  & contributions from tracking group/software core group

NEED MORE VOLUNTEERS to make physics performance plots !